Exploring Playfulness in NIME Design: The Case of Live Looping Tools

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ABSTRACT

Play and playfulness compose an essential part of our lives as human beings. From childhood to adultness, playfulness is often associated with remarkable positive experiences related to fun, pleasure, intimate social activities, imagination, and creativity. Perhaps not surprisingly, playfulness has been recurrently used in NIME designs as a strategy to engage people, often non-expert, in short term musical activities. Yet, designing for playfulness remains a challenging task, as little knowledge is available for designers to support their decisions.

To address this issue, we follow a design rationale approach using the context of Live Looping (LL) as a case study. We start by surveying 101 LL tools, summarizing our analysis into a new design space. We then use this design space to discuss potential guidelines to address playfulness in a design process. These guidelines are implemented and discussed in a new LL tool–called the "Voice Reaping Machine". Finally, we contrast our guidelines with previous works in the literature.

Author Keywords

Playfulness, Play, Ludic design, Live looping, New Interfaces for Musical Expression, User experience

ACM Classification

H.5.5 Information Interfaces and Presentation (e.g., HCI): Sound and Music Computing - Methodologies and techniques, systems; H.5.2 Information Interfaces and Presentation (e.g., HCI): User Interfaces - User-centered design; J.5 Computer Applications: Arts and Humanities - Music.

1. INTRODUCTION

From childhood to adultness, playfulness is often associated with remarkable positive experiences related to fun, pleasure, intimate social activities, imagination, creativity.

In NIME context, in particular, playfulness has been used as a strategy to engage people, often non-expert, in musical activities [22, 16, 25]. In addition, at least two other reasons make us believe that playfulness could be a relevant topic for NIME research.

Firstly, playfulness has been linked to several positive aspects potentially useful in music, such as creativity [23, 30]–arguably essential for any artistic activity. Similarly, in the context of computers, some potential benefits include improved performance, potential to improve learning, higher user satisfaction and attitudes, and positive subjective experiences [29].

Secondly, for the particular case of NIME, because classical approaches towards learning (e.g. pedagogical methods, teachers, and schools) are almost inexistent, we believe playfulness could be a useful strategy for engaging people in practice, yielding in the development of skills in the long term. This direction is suggested by Oore [21] when sharing his personal experiences in learning two NIMEs. Similarly, in sports and psychology literature, some authors highlight the importance of play–in addition to practice–for the development of expertise [7].

Despite this relevance, designing for playfulness remains a challenging task, as little knowledge is available for designers to support their choices. For example: in case we want to design a playful NIME, how should we proceed? How can we make sure we are properly addressing playfulness in our design? In other words, what kind of design decisions should one make so that the resulting NIME is playful?

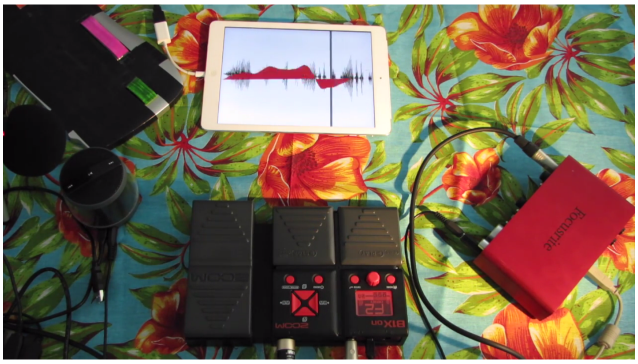

Figure 1: The Voice Reaping Machine.

These are the questions we try to address in this paper by exploring the notion of playfulness in the NIME context. For this goal, we follow a design rationale approach, focusing on Live Looping (LL) as a case study. To start, we survey 101 LL tools, summarizing our analysis into a new design space. We use this design space to discuss potential guidelines to address playfulness in a design process. These guidelines are implemented and discussed in a new LL tool–called the "Voice Reaping Machine", presented in Figure 1. Finally, we contrast our guidelines with previous works in the literature.

2. BACKGROUND

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Playfulness is an ambiguous term with different usages in the literature. For instance, Nijholt [20] defines that interfaces are playful when "users feel challenged or are otherwise persuaded to engage in social and physical interaction because they expect it to be fun." Alternatively, video game researchers [5, 17] address playfulness as a quality that enriches products' market value via a set of pleasurable user experiences, such as sympathy, relaxation, or nurture.

For the context of this work, we define playfulness as *a context-specific tendency that leads people to engage in voluntary, inventive, and imaginative interactions with a system* [26, 29]. In this sense, it relates to open-ended interactions driven by individuals' intrinsic motivation, where enjoyment is the ultimate goal.

The notion of playfulness has been extensively discussed in the Human-computer Interaction (HCI) context. A detailed survey is beyond the scope of this research–we recommend [29] for further details. Here, we focus on a central issue: the state/trait nature of playfulness.

An early study to address playfulness–as defined here–in the context of HCI is [26]. The construct is defined as a trait–a pattern in an individual's behavior that is recurrent over time. In other words, playfulness was considered as a characteristic present in certain personalities that yields a predisposition to be playful–no matter the tools used in the interaction or the context. This characteristic is also known as "autotelic personality" [26].

On the other hand, some authors argue that playfulness could potentially be addressed as a state–a short-timed condition, where several context–specific factors related to the interaction (e.g. the difficulty of the task executed, the ability of the individual in dealing with that tasks) could impact the achievement of this playful state. In this case, the assumption that the context of the interaction has little or no impact on playfulness is no longer valid: in fact, here the context becomes critical.

Considering playfulness as a state, [27] suggests that playfulness could be investigated through the lenses of the flow theory [8]. This theory relies on the flow state: an optimal condition, characterized by a high degree of enjoyment and involvement, in which people become totally immersed in performing an activity due to a perfect balance between the challenges offered by the tasks and the skills possessed by the individual. If the activity is too easy, it yields boredom; if too challenging, it yields anxiety. Dimensions that compose flow include: (1) Control, defining the sense of control users feel over the process and the activity's outcome; (2) Attention focus, defining to what extent users were distracted or absorbed while performing the activity; (3) Curiosity, representing the degree of imagination and curiosity stimulated while performing the activity; and (4) Intrinsic interest, defining to what extent users were voluntarily engaged and motivated by the activity.

2.1 Playfulness in NIME

There is a relatively little amount of research dedicated to playfulness–as defined here–in the context of NIME. In addition, for some of the cases that do address playfulness [16, 25], little effort is made to either justify design decisions or discuss which characteristics have made that particular design playful. Here, we cover two works that go beyond this limitation.

The first one is [22]. In this practice-led research, playfulness was used as central guideline for designing simple fun–focused musical interfaces (i.e. toy-like instruments), aiming at non-musicians.

Four projects are presented: (1) The Piano cubes, two square jam jar embedded with tilt sensors, each one mapped to the direction and the tempo of a four-notes piano arpeggio; (2) The Bullroarer, a digital version of this ancient musical instrument composed of a piece of wood and a rope; (3) The Stretch, a latex rubber surface embedded with slider variable sensors in a square frame; and (4) The "When I think of heaven", a wall-sized square instrument that combined four different Stretch interfaces with two drum pads. For each of these, the author discusses motivation and evolution of the designs, summarizing his experience in three key conclusions: (1) Novices tend to enthusiastically explore playful interfaces when these are open ended and hide user's lack of expertise; (2) Social collaboration can be useful to encourage play; and (3) Mapping is one of the most challenging steps in designing playful interfaces.

It is important to note that playfulness here is limited to toy-like interfaces which, although fun and simple to use, could potentially be quickly mastered and forgotten by users. This characteristic is often undesirable in the context of NIME [28].

Another example, more recent, is [19]. The author introduces the D-Box, a simple and straightforward (i.e. only three basic sensors are available for performers to interact with) DMI that, despite its simplicity, was purposely designed to be opened, and modified (i.e. hacked) by its users, aiming at playful engagement in this hacking process. In this sense, the author follows the idea of designing for ludic engagement, as defined by [11].

This DMI was investigated over two workshops in the UK with 17 diverse-backgrounded participants focused on understanding how they use the D-Box. Results–presented according to three stages: before participants opened the D-Box, during the hacking, and after D-Boxes were anonymously exchanged among participants–focused on issues such as: (1) Sense of ownership after the hacking (i.e. participants reported connection to their own hackings, and disappointment with the one received in the exchange); (2) Patterns in the exploratory behavior when hacking the instrument (i.e. the caution random walk); and (3) The limited initial affordances. Little is said, however, about the design process of the instrument, and about how playfulness was built throughout this process.

3. METHODOLOGY

Our work has four basic underlying assumptions:

1. Playfulness is a state, and because of that, people can be more prone to playfulness depending on the characteristics of the context;
2. Performers can achieve a state of playfulness in the context of musical practice with NIME;
3. The NIME itself plays a role in achieving this playful state (i.e. it is possible to design instruments that are more "playfulness inducers" than others); and
4. We can foster this playfulness by addressing the conditions that might lead to *flow*.

Framed by these assumptions, our goal is to explore how to design NIMEs that effectively facilitate playfulness among performers. For this, we decided to use a design rationale-inspired methodology [18], aiming at describing and reasoning our decisions throughout our design process. Our methodology is based on five steps: a) *choose a case study*; b) *survey of existing tools*; c) *create a design space*; d) *exploring potential guidelines for achieving playfulness*; and e) *iteratively prototyping solutions*. These steps are presented in the following sections.

3.1 Choose a case study

For the scope of this study, we decided to focus on the context of Live looping [2]. Live looping is a musical technique based on looping audio samples recorded in performance time by the performer himself/herself.

We believe that choosing LL as case study is beneficial for two reasons.

First, because LL tools share a standard set of core functionalities (e.g. record, play, stop, and overdub), different LL tools might allow performers to achieve the same kind of musical results (i.e. one performer could likely replicate the same musical excerpt in different LL tools). How these functionalities are implemented, however, (e.g. a pedal, a desktop application, etc.) is specific to each individual tool. We believe this restriction is essential to allow comparison between different implementations.

Second, artists such as Reggie Watts[1] and Dub Fx[2] demonstrate how LL tools afford a new particular set of skills, built upon their skills with their musical instruments (in the case of these artists, the voice). This new set of skills suggests that LL tools can be considered as musical instruments by themselves, and are therefore representative as case study.

3.2 Survey of existing tools

There is a wide variety of devices that implement LL. As a first step, we have surveyed and analyzed live looping tools produced by the music technology industry, academic studies, and independent developers. In total, 101 tools were surveyed. The result of this survey and analysis is available online[3].

This survey allowed us to get a sense of how designers approached the design of new LL tools, especially concerning similarities and differences of each one. This allowed us to develop the design space [4, 13] introduced in the next subsection.

3.3 Create a design space

From our survey of LL tools, we identified five dimensions representing relevant aspects of LL tools. We planned to make these dimensions orthogonal, with little or no intersection between them (the only exception concerns the visual feedback). These dimensions are:

Looping capabilities: Defines the range of musical possibilities provided by the looping device. It is a continuous scale that ranges from *basic* (set of standard functionalities consisting of record, overdub, play, stop, and delete, as implemented in the Boss RC-1) to *advanced* (e.g. individual layer control, as in the Loopy) functionalities;

Input capacity: Defines the amount of standard input controls visible to the user for the interaction (e.g. buttons, knobs, touch screen, etc). This dimension relates to the notion of input capacity as defined by [13], concerning the capabilities of an input device for capturing information from user interaction. Here, it is represented by a continuous scale from *low* (as in the Ditto Looper, which has only a foot-switch and a knob) to *high* (as in the Roland MC-09, which provide approximately 51 buttons, 8 knobs, and 4 sliders);

Mapping directness: Defines how the looping functionalities are made accessible for the user via the input controls. This accessibility can be *direct* (i.e. similar to an one-layer mapping [14]), when a certain functionality is directly accessible to users when they use a input control (e.g. pressing a foot-switch to record and overdub in the Vox Lil'Looper). Contrarily, this accessibility can be *indirect* (i.e. similar to a multiple-layered mapping [14]), when users need to navigate in the interface until the point they are able to either enter a "looper mode" or find the desired functionality (as found in multi purpose software such as the Ableton Live);

Visual feedback role: Defines what role visual feedback plays in the looper. This role can be: a) *Limited*, where visual feedback–if present–happens only when user interacts with input controls (e.g. the Digitech DL-8); b) *transparent*, where visual feedback allows users to quickly infer the current status of the system (e.g. the Boss RC-1); and c) *ornamental*, where visual feedback works as aesthetic decoration for the device, with no correspondent in terms of functionality (e.g. the drawing aspects of the Illusio);

Visual feedback intensity: Defines how much of visual feedback the device can provide, ranging from *low* (e.g. the single small LED provided by the TC Ditto Looper), to *high* (e.g. the full monitor screen visual interface of the Freewheeling).

[1]`https://reggiewatts.com/`
[2]`https://dubfx.com/`
[3]`https://goo.gl/9a7m9Z`

3.4 Explore potential guidelines for achieving playfulness

Considering this design space, our surveyed tools, and previous works in the literature, how can we design live loopers that facilitate playfulness? We propose three key guidelines presented in the following subsections.

3.4.1 Advanced looping capacity

All live looping tools share a basic set of functionalities that are at the core of live looping performance (i.e. record, overdub, play/stop, and clear). Few are, however, the tools that go beyond this basic set, expanding the musical possibilities of live looping.

In order to address the conditions that may lead to flow (and therefore promoting playfulness), we argue that providing advanced looping capacity is essential. Curiosity raised by the new musical possibilities might yield exploratory use, which has been linked to flow's intense concentration and enjoyment [12]. Furthermore, advanced functionalities may afford the development of new skills for expert users, without compromising the basic functionalities for novice users. This aspect can help users find their own balance between challenge and skills–essential for achieving the flow state.

One straightforward design strategy for implementing high looping capacity is either to incorporate extra functionalities provided by existing tools or to brainstorm innovative functionalities not yet addressed these existing tools. Another strategy is to "absorb" expert techniques inside the tool–as suggested by Cook's third principle [6].

3.4.2 Low input capacity and direct mappings

Providing low input capacity means reducing the number of standard input controls immediately visible to users for the interaction. Additionally, providing direct mappings means that functionalities–both basic and advanced–should be directly accessible via input controls.

The motivation is trying to make the device easier to get started with by: a) reducing confusion that a high number of input controls may cause to new users; and b) coupling the reduced number of input controls with the usage of direct mappings (e.g. arguably, providing a single button for navigating many different functionalities could result in more challenging initial ease of use). This aspect, again, could help users with different levels of expertise to find the balance between challenge and skills required for flow.

Another argument is that, because mappings are direct, performers could spend less time dealing with actions that do not have a direct impact in the musical outcome (e.g. interface navigation). As a result, we allow them to better focus their attention on the musical activity–another key requirement for the flow state.

It is important to note that this guideline does not necessarily yield NIMEs that are "easy to use" or "easy to master". The number of input controls can be low and their mapping direct, but still it may be challenging to meaningfully control them in a musical sense. A practical example is the theremin, which, despite intuitive and easy to get started, is arguably hard to master. This idea of instruments with "low entry fee and high ceilings", discussed in [28].

3.4.3 Transparent and intense visual feedback

This guideline means that visual feedback should be provided and guided towards: a) allowing user and the audience to infer what is going on inside the device (i.e. visual feedback should be transparent); and b) exploring highly visible visual displays as output, so that they can be easily perceived by performer and audience.

The importance of visual feedback for NIME has been discussed by several previous works [9, 24]. We believe this guideline may facilitate playfulness and flow because it may help in promoting transparency–that is, how much people (mainly the audience and non-expert users) perceive the connection between the performer's gestures and the sounds produced [10]. Furthermore, visual feedback also affords potential to make the tool more intuitive [15], contributing for initial ease of use.

Some concrete strategies on how to implement this guideline can be found in the literature. Examples include using visual metaphors, and exploring perceptual sound parameters (e.g. loudness) [1].

3.5 Iteratively prototype solutions

The previously mentioned guidelines led us to develop low-fi prototypes of new live looping devices–represented in Figure 2[4]. Some of them evolved to the "Voice reaping machine", that is presented in the next section.

4. IMPLEMENTATION

The LL tool designed to implement these guidelines is called the Voice Reaping Machine (VRM)–already presented in Figure 1. The tool is composed by: a) an iPad application developed in C++/Openframeworks; and b) a modified-keyboard that works as two foot-switches.

In the following subsections we discuss how we implemented each guideline in this particular prototype.

4.1 Advanced looping capacity

In addition to the standard basic functionalities, the VRM presents three innovative functionalities when compared to existing LL tools: a) the capacity of easily setting the playback position of the looping; b) the capacity of easily resetting a new looping area inside the original loop; and c) the capacity of creating additional voices to the loop, by combining either two playback positions or two looping areas playing together at the same time. This process is shown in Figure 3.

The combination of these functionalities makes the VRM unique when compared to existing LL alternatives, providing it with a peculiar advanced looping capacity.

[4]Videos of these prototypes can be found in: https://youtu.be/7OpCP26LXxA; https://youtu.be/CAiVWvVFaqI; and https://youtu.be/oRpVfqern6s

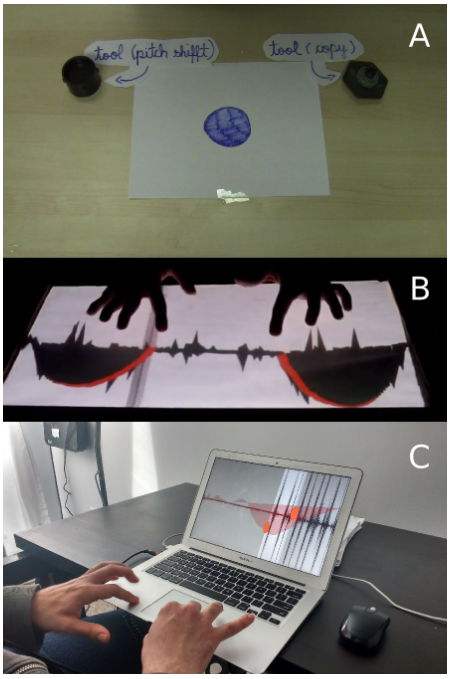

Figure 2: Several prototypes were designed for exploring our guidelines. In addition to paper sketches, we also built (A) a video prototype; (B) a functional prototype using a DIY multitouch table; and (C) another functional prototype using the computer's trackpad.

4.2 Low input capacity and direct mappings

Concerning the standard basic functionalities, the VRM emulates the foot pedal-based interaction style used by the most simple loopers in our survey. As a consequence, all standard basic functionalities are directly accessible via the modified keyboard. For example, to record, the user needs to press the foot-switch at the beginning and again at the end points of the musical phrase to be looped. The same actions allow overdubbing if executed whenever some musical material is looping. Play and stop can be also be directly accessed via the foot-switch. Clearing is possible by holding the main foot-switch by two seconds.

Regarding the three advanced functionalities, they were made accessible via incremental touch interaction and direct manipulation of the object of interest (the sample), as follows:

One finger added: The user is able to control the playback position of the looper (the finger X position), and the volume of the playback (finger Y position);

Two fingers added: The user is able to set a looping subarea, where the begin position is the left-most finger X position, and the end position is the right-most finger X position. In both case, volume is defined by interpolation of the Y position of both fingers;

Three fingers added: In this case, users can perform both actions defined above at the same time. In other words, they can: a) set and control a looping subarea

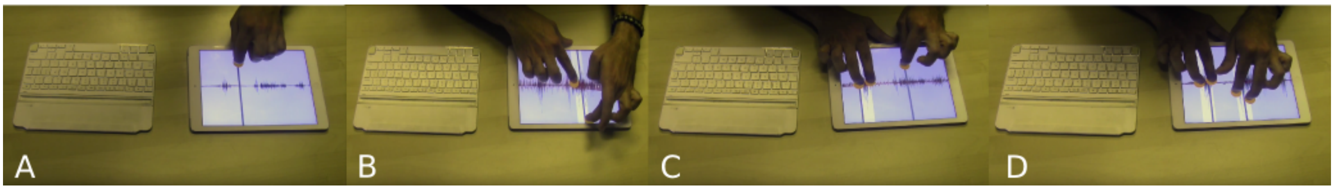

Figure 3: The advanced functionalities introduced by the VRM represented in terms of its incremental touch interaction: (A) one finger in the tablet screen results in control of the playback position; (B) two fingers result in redefining the looping area; (C) three fingers result in controlling the playback position *and* redefining the looping area; and (D) four fingers result in two looping areas playing in parallel.

Table 1: Contrasting different guidelines for playful NIMEs

Work	NIME	Guidelines
Robson [22]	*The Piano cubes*; the *Bullroarer*; the *Stretch*; and the *"When I think of heaven"*	(1) Novices tend to playfully explore interfaces when these are open ended and hide user's lack of expertise (2) Social collaboration can be useful to encourage play (3) Special focus on mapping because it is one of the most challenging steps in designing playful interfaces.
Troyer [25]	The *DrumTop*	(1) Explore everyday gestures and objects for interaction (2) Explore the natural feedback provided by these physical objects
McPherson et al. [19]	The *D-Box*	(1) Initial simplicity and limited input capacity (2) Purposely designed to be opened, and modified (i.e. hacked) by its users, affording more complex interaction
Our guidelines	The *Voice Reaping Machine*	(1)Provide advanced looping capacity (2) Provide low input capacity and direct mappings (3) Provide transparent and intense visual feedback

(as in 'two fingers added'); and b) control the playback position of the looper (as in 'one finger added');

Four fingers added: Here, users are able to select two looping subareas (as a doubled 'two-fingers added').

4.3 Transparent and intense visual feedback

Visual feedback is at the core of the VRM, and was designed in order to highlight the high level mechanisms of the looper [3]. It basically consists of a timeline showing the waveform of the recorded loop and a gray line indicating the playback position of the loop. In addition, live audio input is provided by the interface, in order to allow input monitoring.

All elements are responsive to user actions (e.g. recording or overdubbing changes to background color to red, areas outside a looping subareas are made gray, and so on), allowing performer and audience to infer accurately what is happening inside the device (i.e. transparency). For this goal, all the tablet screen is dedicated to the interface, in order to maximize visual feedback intensity.

5. DISCUSSION

We note that there is still some open questions raising from our work. For instance: If the VRM is more playful than other LL tools, is it because of the strategies we used? What consequences would this playfulness bring for the LL practice–in particular, for user engagement, willingness for practice, and skill development?

To clarify these questions, further empirical investigations are needed. Such studies would complement the *formative evaluation* used here, derived from our design rationale-inspired methodology, and would allow us to concretely assess strengths and weaknesses of the VRM.

Finally, our guidelines were contrasted to other guidelines from the literature. This contrast is summarized in Table 1.

Despite the different contexts (musical toys, live looping, etc), it is interesting to note how the idea of *simple interaction* seems somehow always present–by allowing novices to simply produce musical results above their capacity [22]; by exploring everyday objects potentially familiar to users [25]; or by providing a low input capacity as proposed here. We believe further research is needed in this direction.

6. CONCLUSION

In this paper, we have explored the notion of playfulness for NIMEs, specifically in the context of live looping tools. Our main contributions are: a) a survey and analysis of 101 existing LL tools; b) the definition of a design space for LL; c) a set of design guidelines for playful LL tools, using our design space as baseline; and d) a practical implementation of these guidelines in a new LL tool, the "Voice Reaping Machine". In the larger picture, we hope these contributions can provide some preliminary knowledge on how to effectively address playfulness in a NIME design.

7. ACKNOWLEDGEMENTS

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